US009347505B2

(12) **United States Patent**
Noborio et al.

(10) **Patent No.: US 9,347,505 B2**
(45) **Date of Patent: May 24, 2016**

(54) **DISC BRAKE CALIPER AND BASE MEMBER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 46 days.

(21) Appl. No.: **14/169,027**

(22) Filed: **Jan. 30, 2014**

(65) **Prior Publication Data**

US 2015/0210345 A1 Jul. 30, 2015

(51) **Int. Cl.**

B62L 1/00	(2006.01)
F16D 65/00	(2006.01)
B62L 3/02	(2006.01)
B62K 19/38	(2006.01)
F16D 55/228	(2006.01)
F16D 65/18	(2006.01)
F16D 121/04	(2012.01)

(52) **U.S. Cl.**

CPC ***F16D 65/0056*** (2013.01); ***B62K 19/38*** (2013.01); ***B62L 3/023*** (2013.01); ***F16D 55/228*** (2013.01); ***F16D 65/0068*** (2013.01); ***F16D 65/0075*** (2013.01); ***F16D 65/18*** (2013.01); *F16D 2121/04* (2013.01)

(58) **Field of Classification Search**

USPC 188/26, 72.4, 73.31

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,230,849	B1 *	5/2001	Lumpkin	188/24.12
2006/0231351	A1 *	10/2006	Kariyama	188/26
2009/0200121	A1 *	8/2009	Takizawa et al.	188/72.5
2013/0048444	A1 *	2/2013	Hirotomi et al.	188/73.31
2014/0083805	A1 *	3/2014	Hirotomi	188/73.31
2015/0001012	A1 *	1/2015	Noborio et al.	188/72.4
2015/0001014	A1 *	1/2015	Noborio et al.	188/73.31

* cited by examiner

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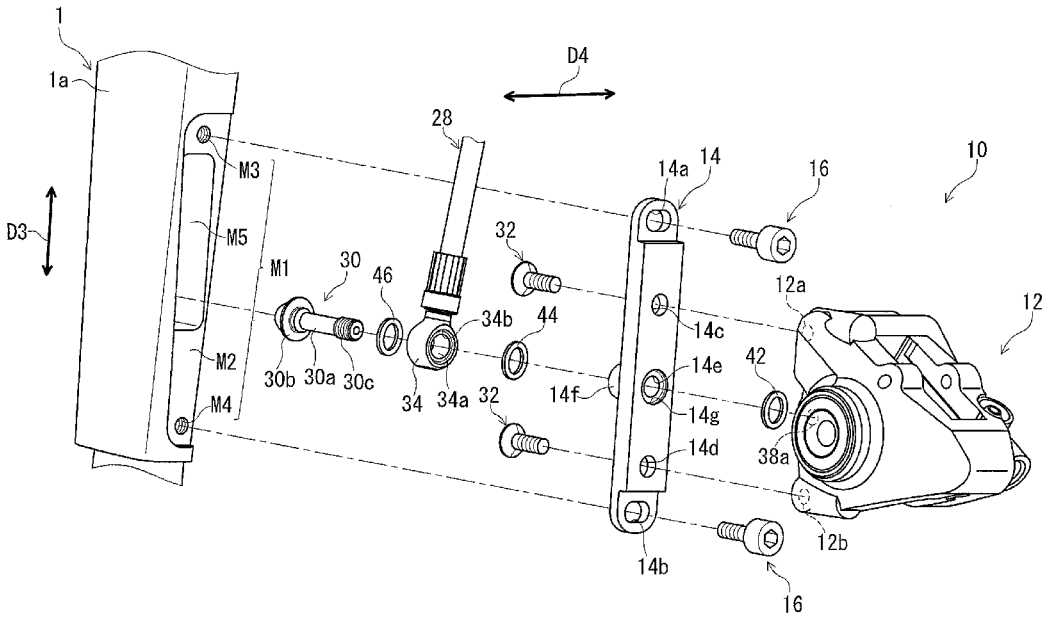
(57) **ABSTRACT**

A disc brake caliper comprises a caliper main-body. The caliper main-body includes a facing surface and an attachment structure. The facing surface is configured to face a mounting portion of a bicycle frame to which the disc brake caliper is attached. A connecting member is to be attached to the attachment structure. The connecting member is configured to be connected to a fluid hose. The attachment structure is provided on the facing surface.

24 Claims, 16 Drawing Sheets



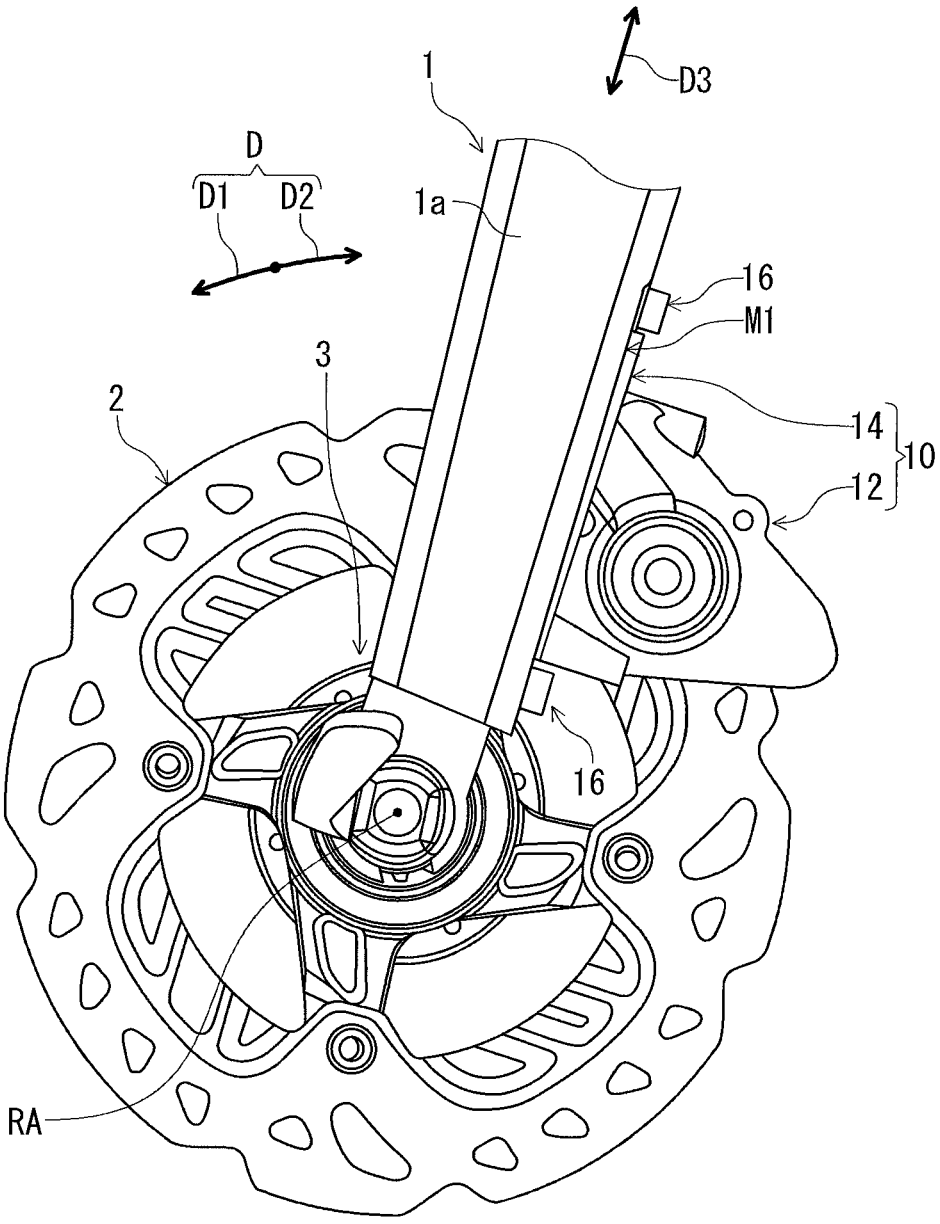


FIG. 1

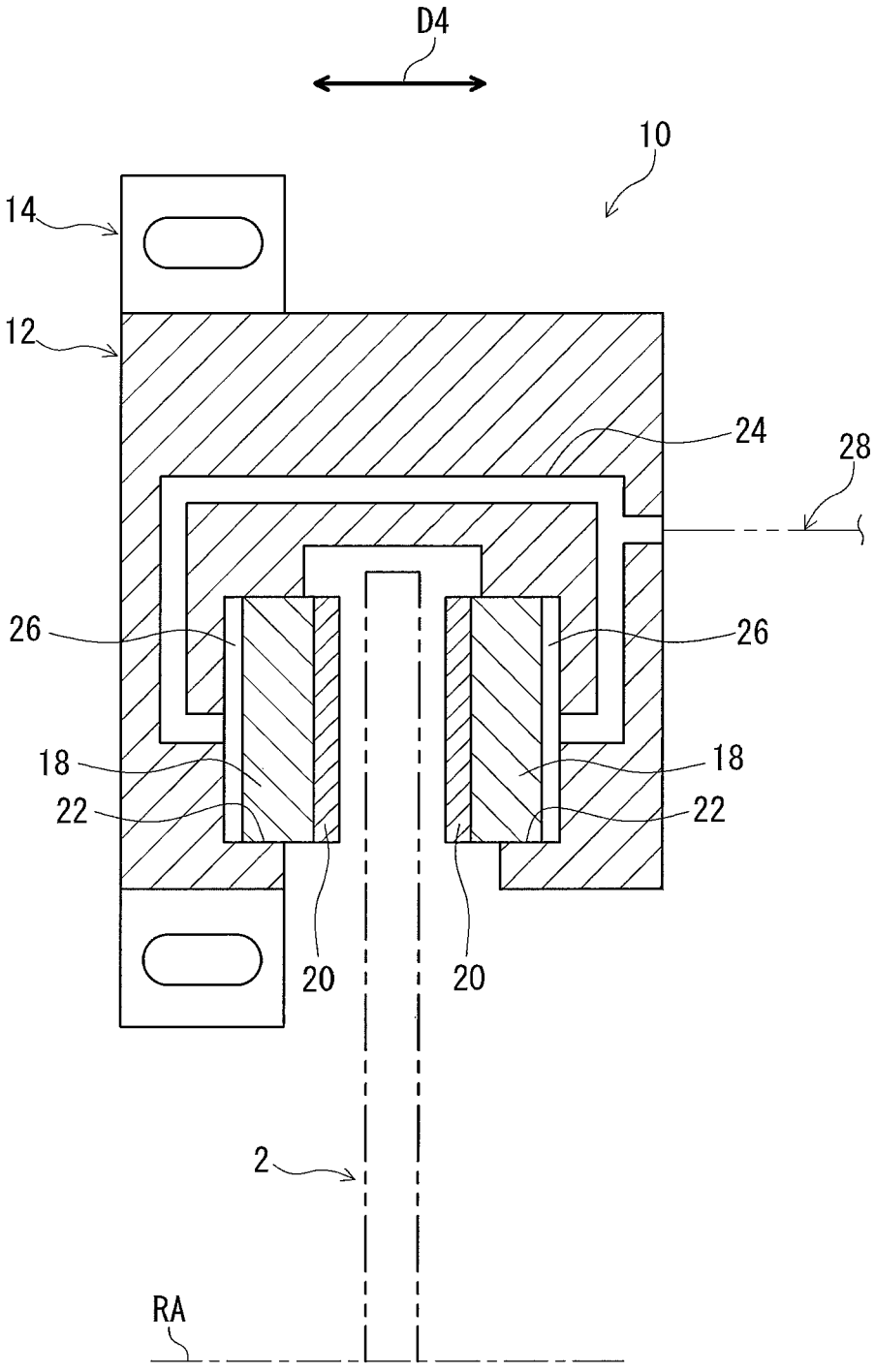
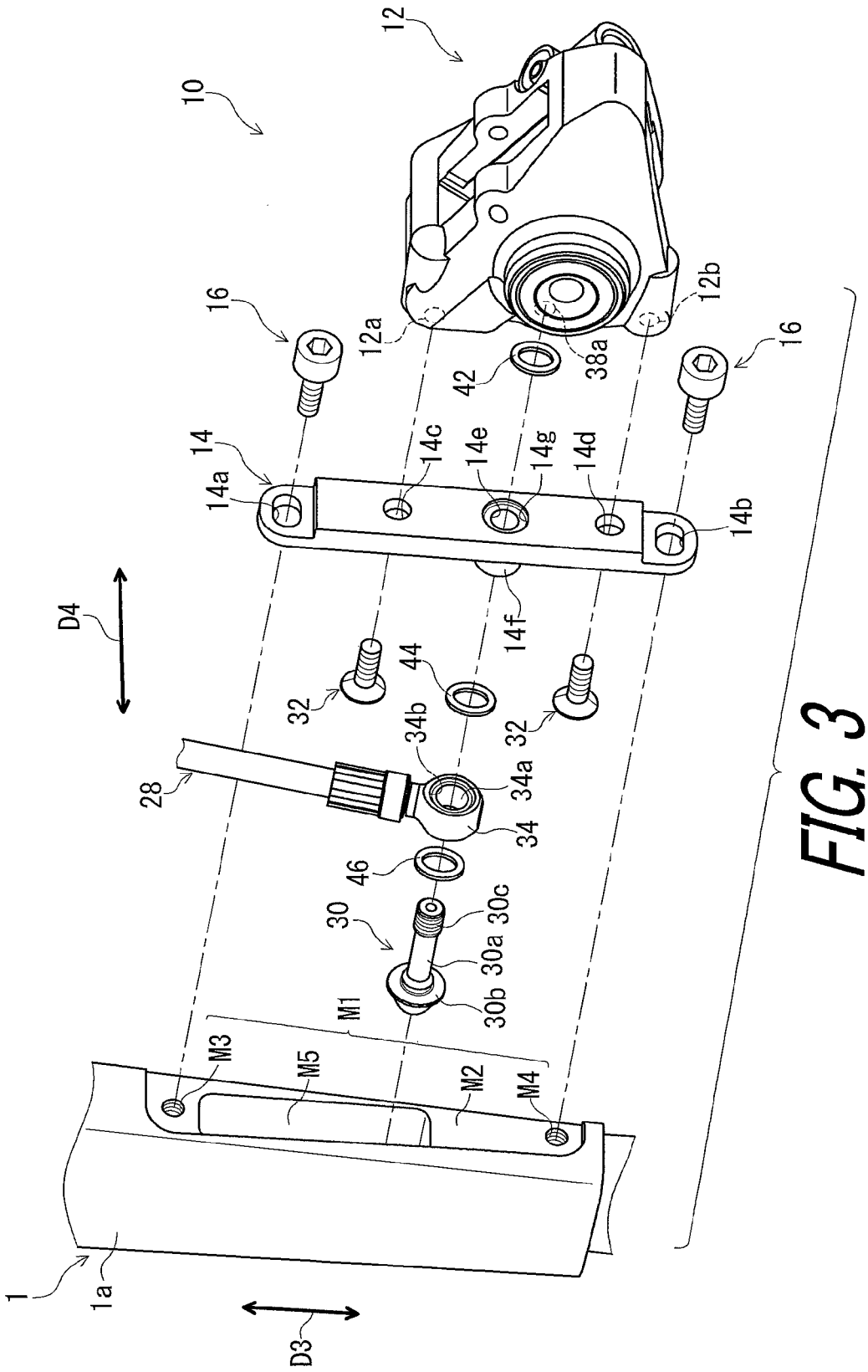


FIG. 2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38a
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14a
14c
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44
32
34b
34a
28
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30c
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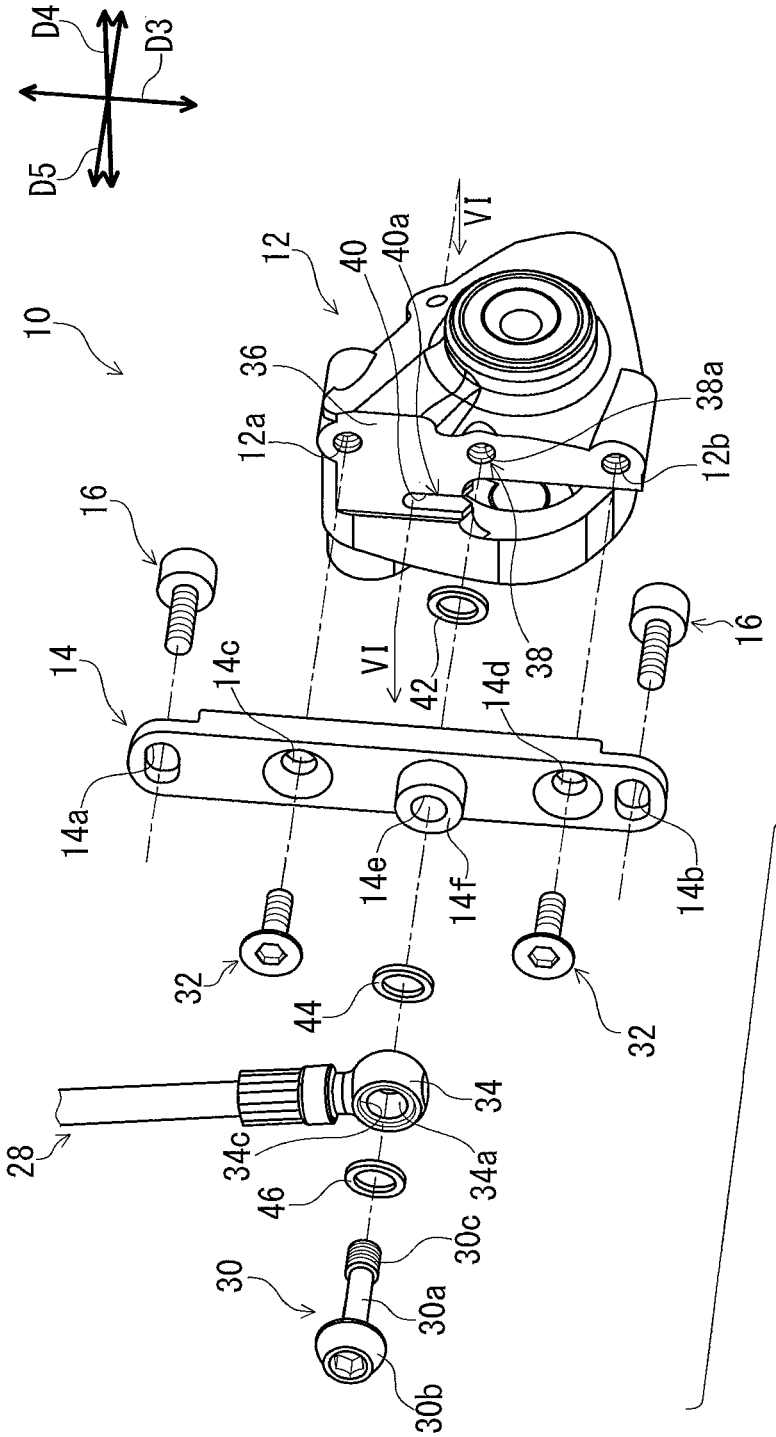
M1
M3
M5
M2
M4
1
1a
D3

FIG. 3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38
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34a
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30c
30
30a
30b

FIG. 4

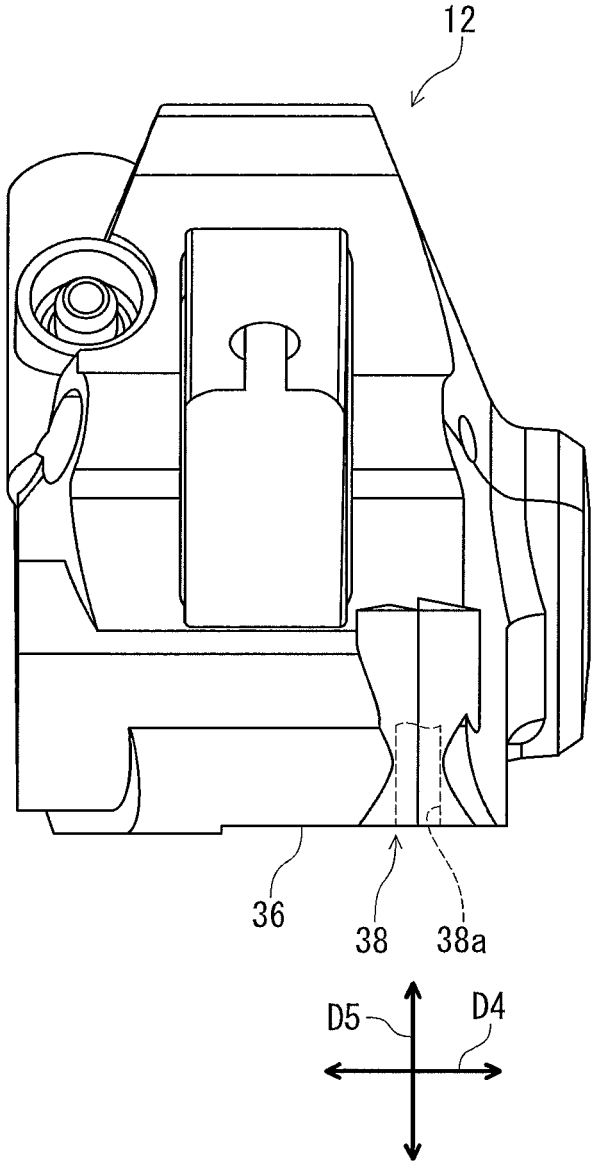


FIG. 5

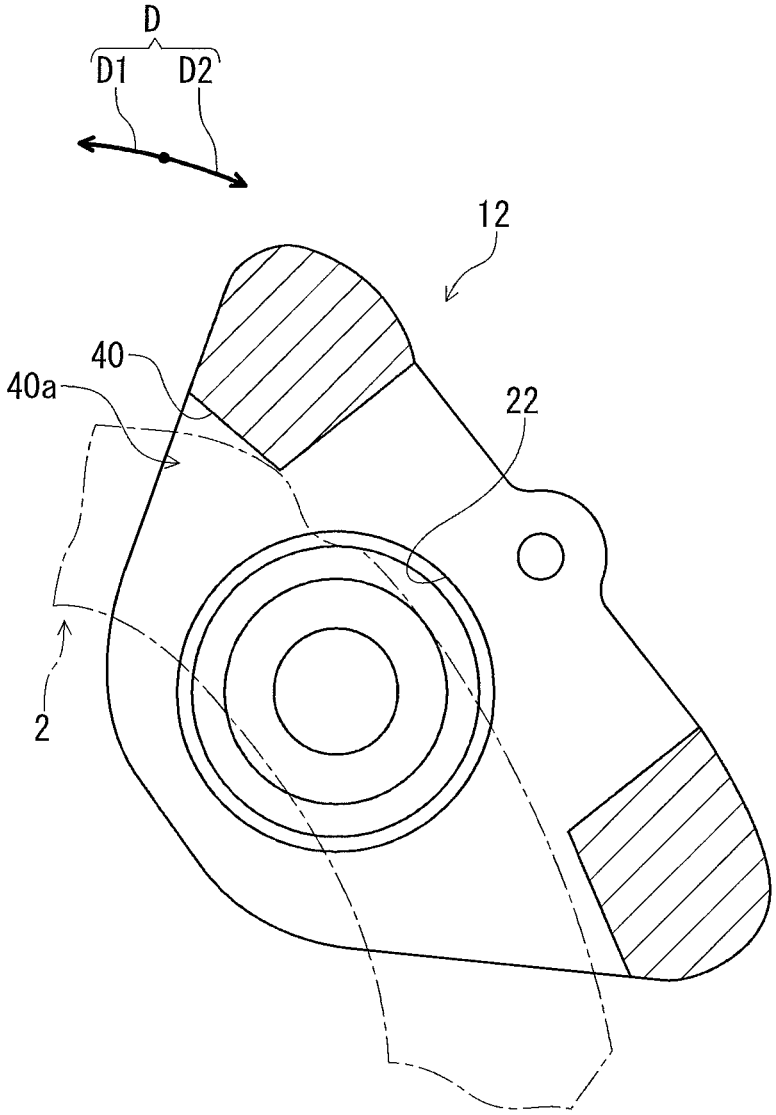
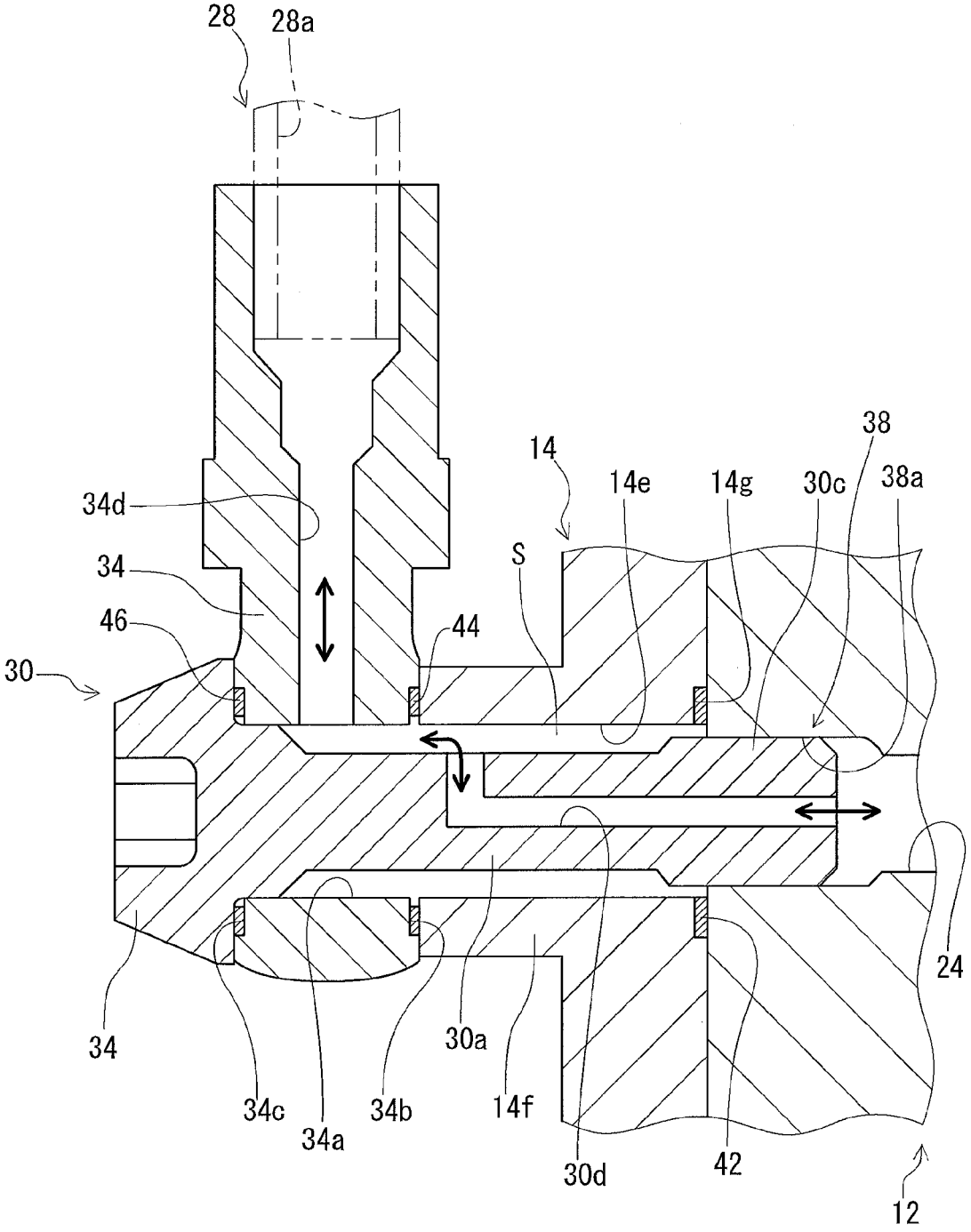


FIG. 6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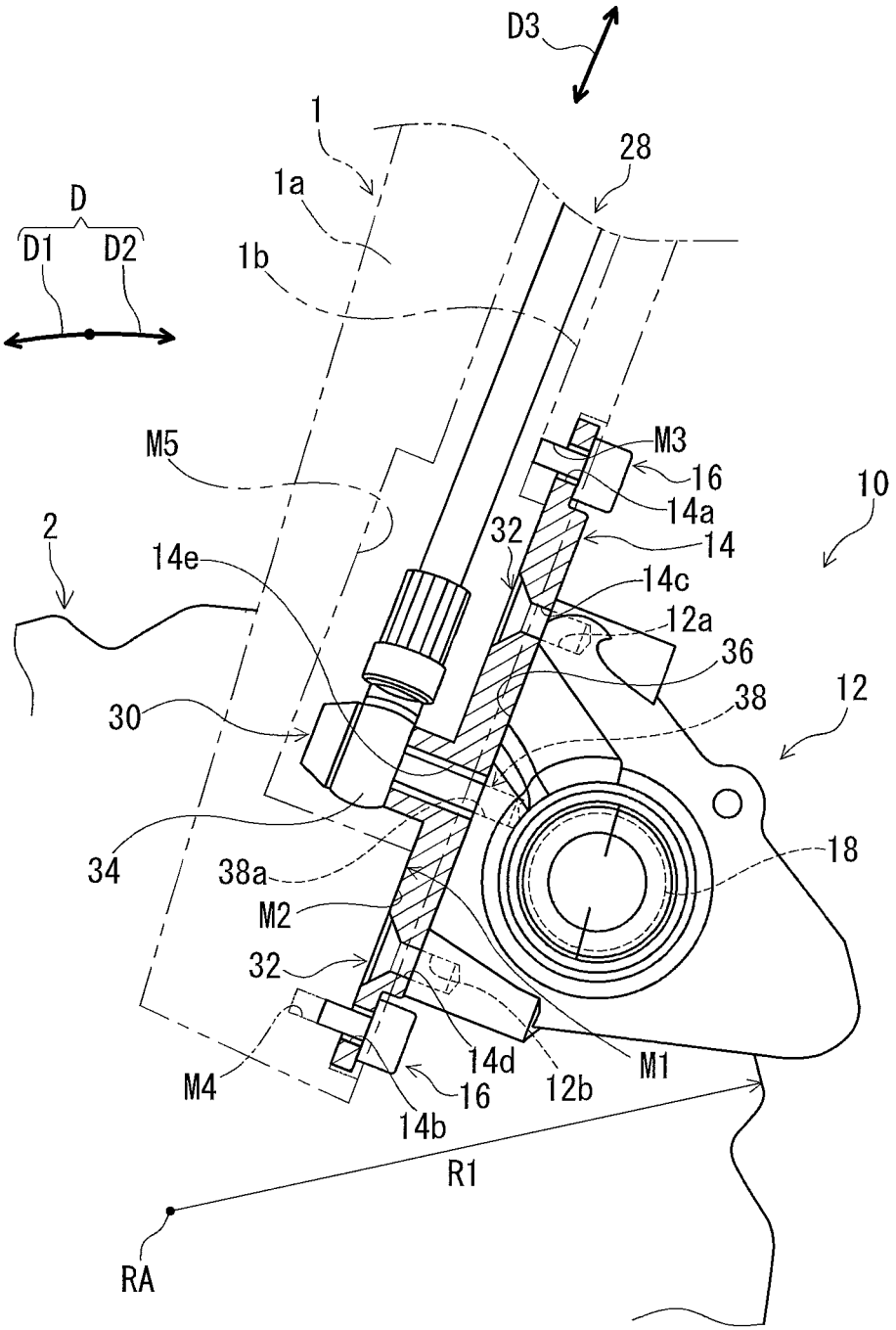
34b
14f
30d
42
12

FIG. 7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12a
36
38
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30
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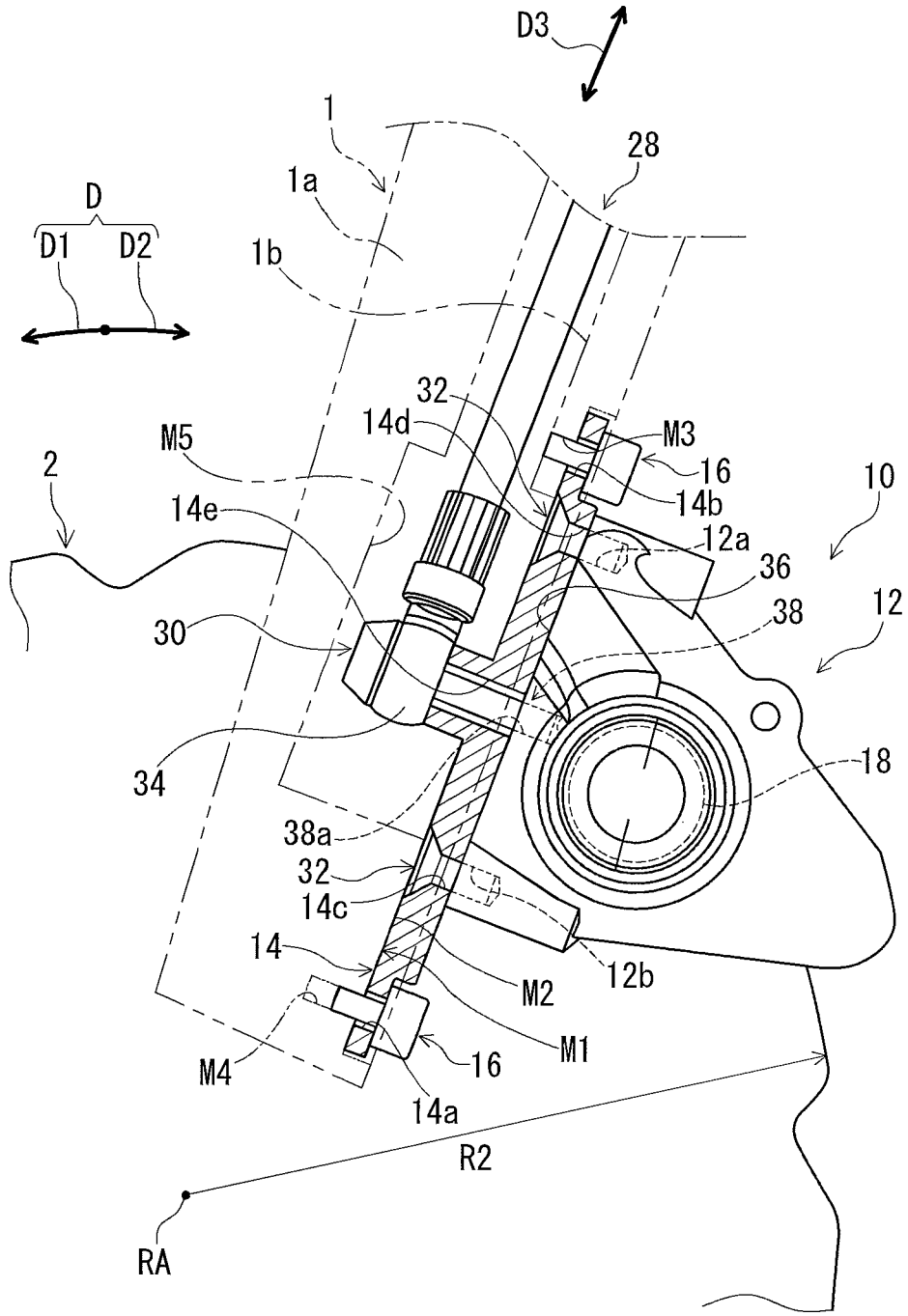
38a
18
M2
32
M4
14d
M1
16
12b
14b
R1
RA

FIG. 8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38
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14c
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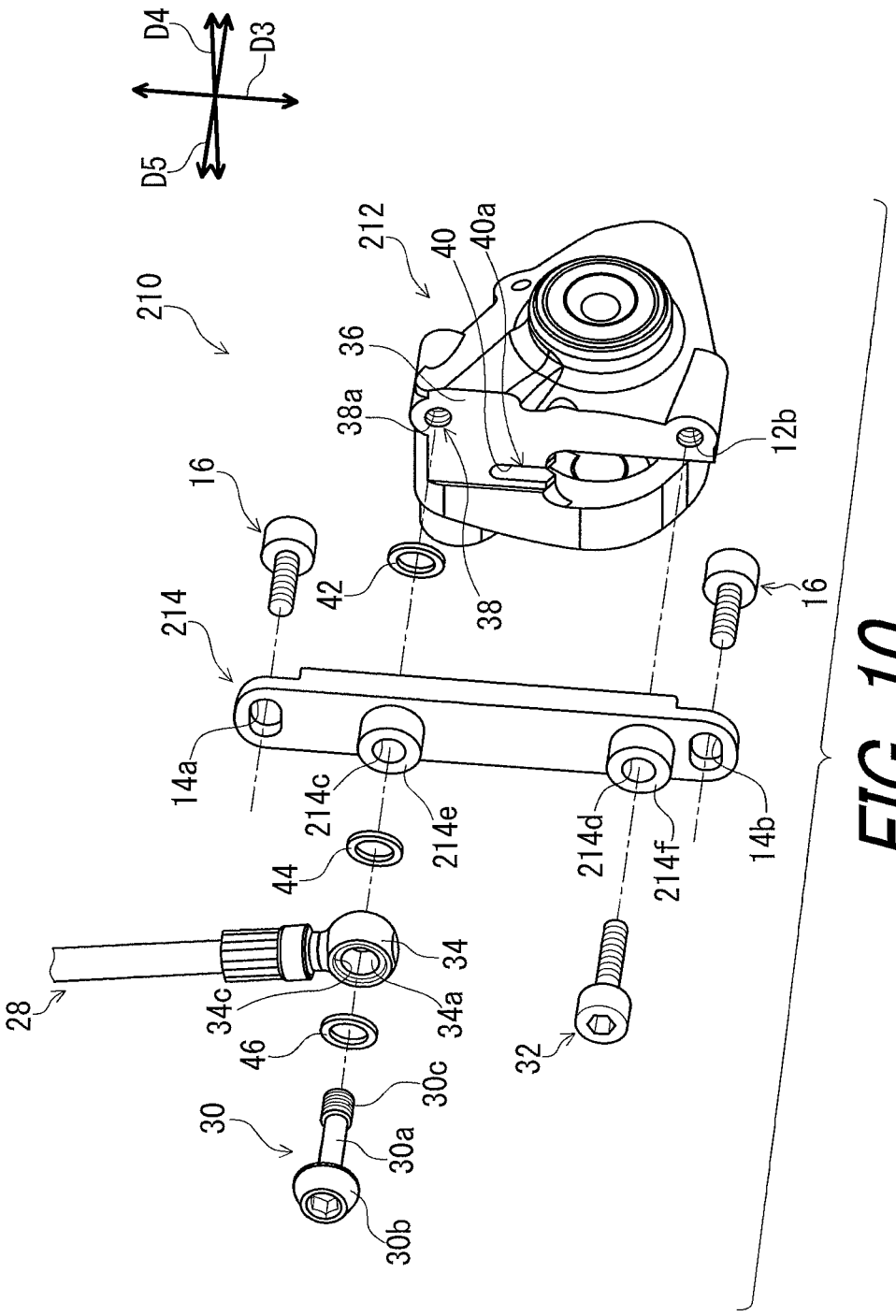
12b
M2
M1
M4
16
14a
R2
RA

FIG. 9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214f
14b
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28
34c
34a
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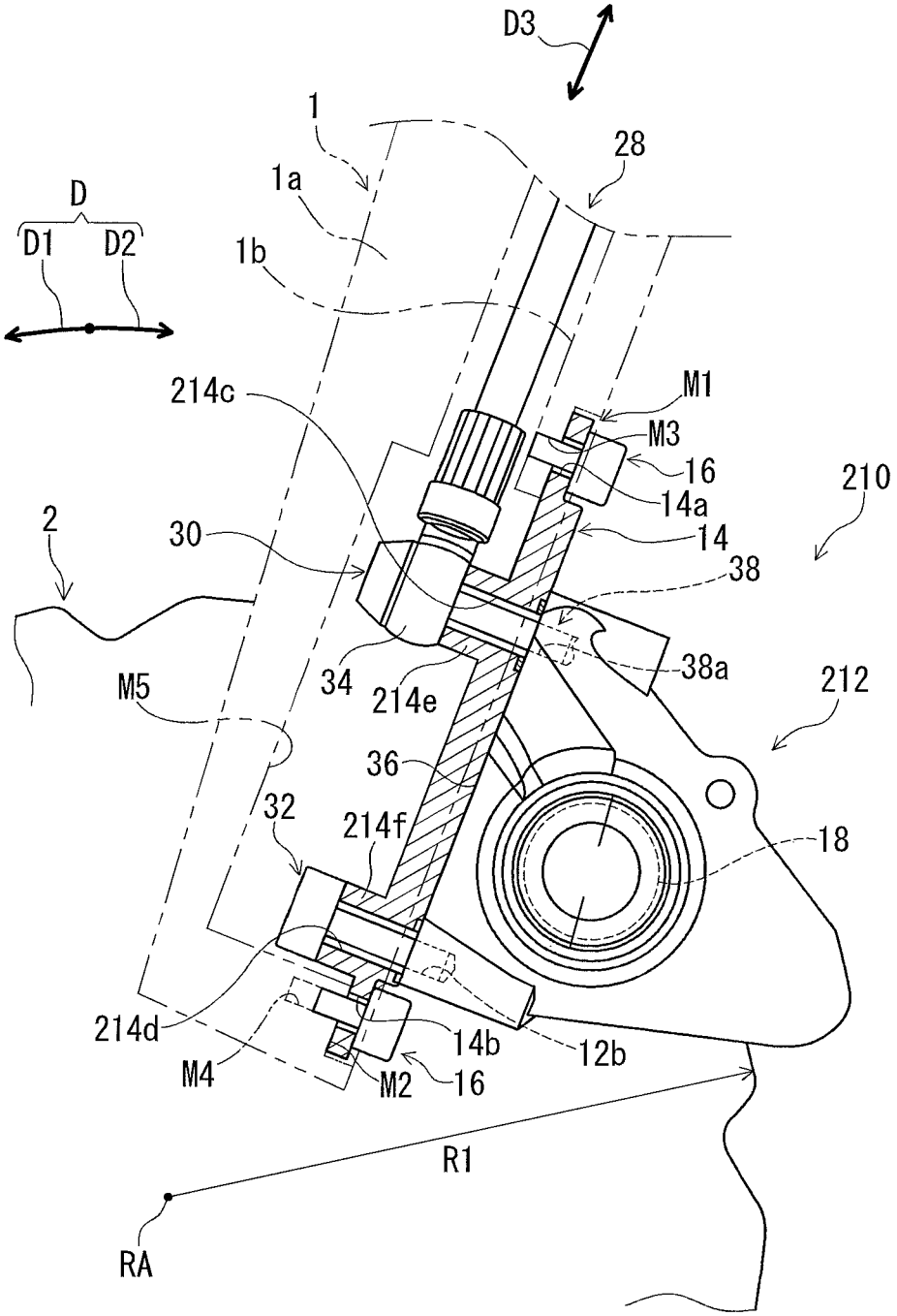
32
30c
30
30a
30b

FIG. 10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38a
212
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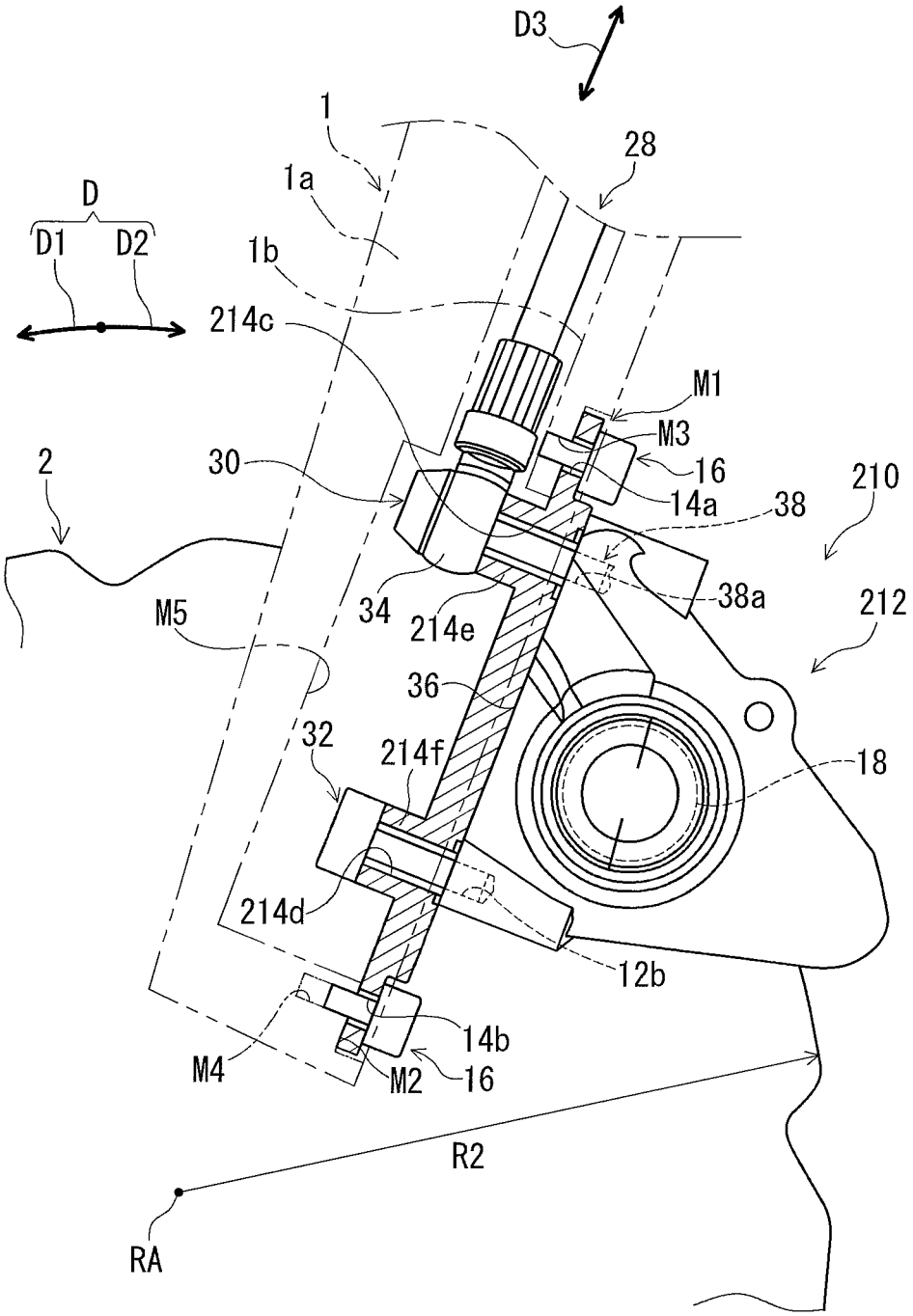
214f
18
214d
14b
12b
M4
M2
16
R1
RA

FIG. 11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M5
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214f
18
214d
12b
14b
M4
M2
16
R2
RA

FIG. 12

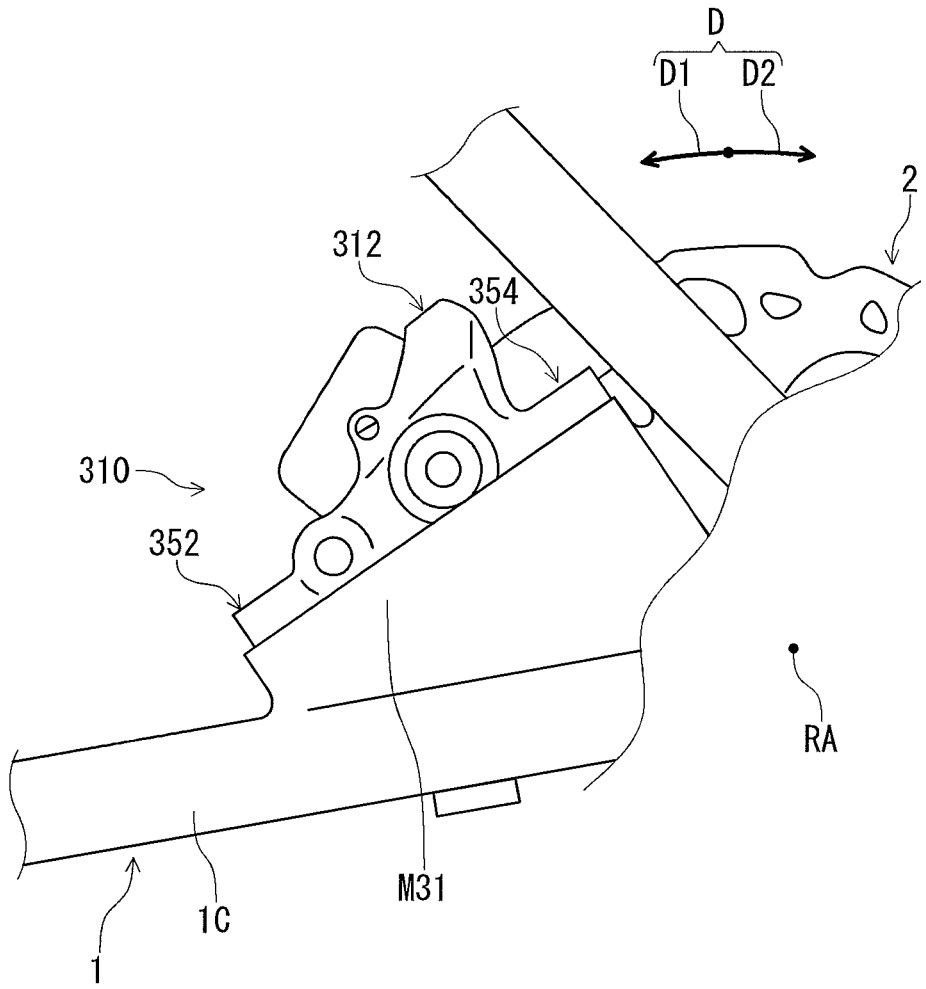


FIG. 13

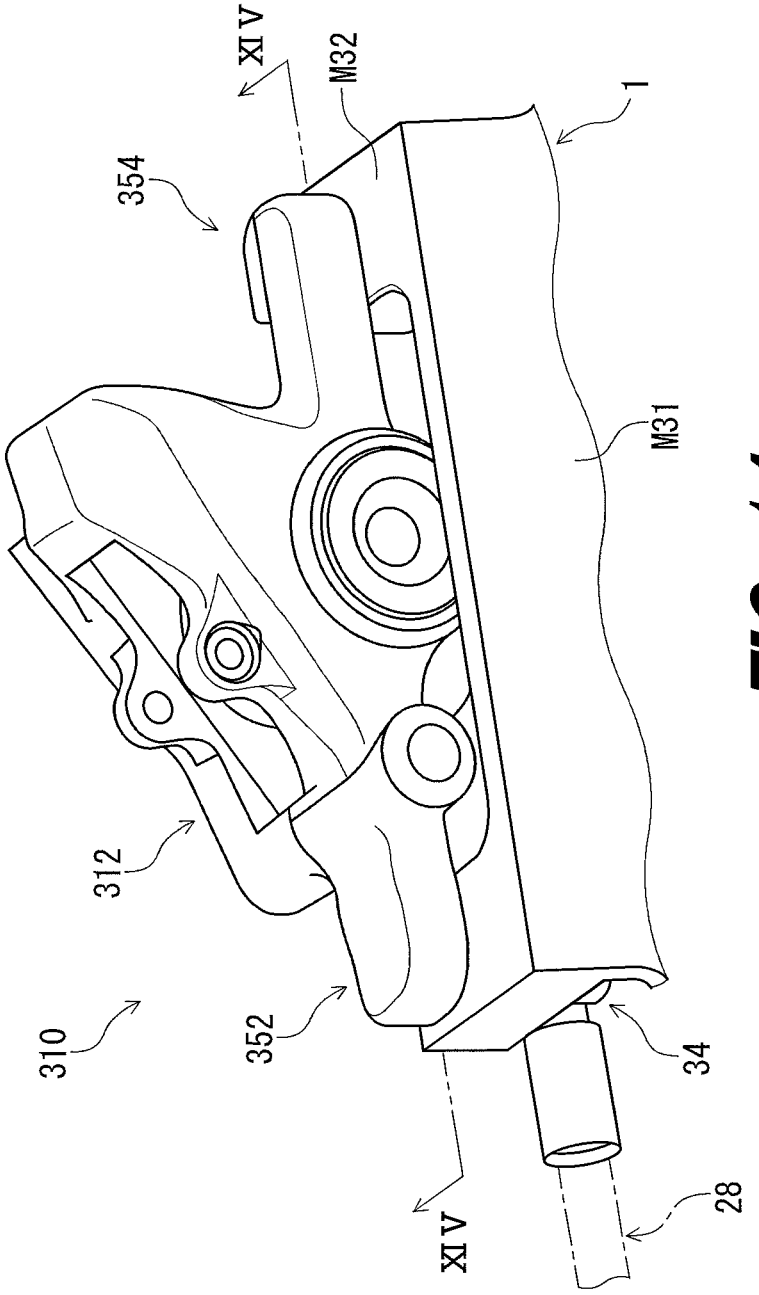
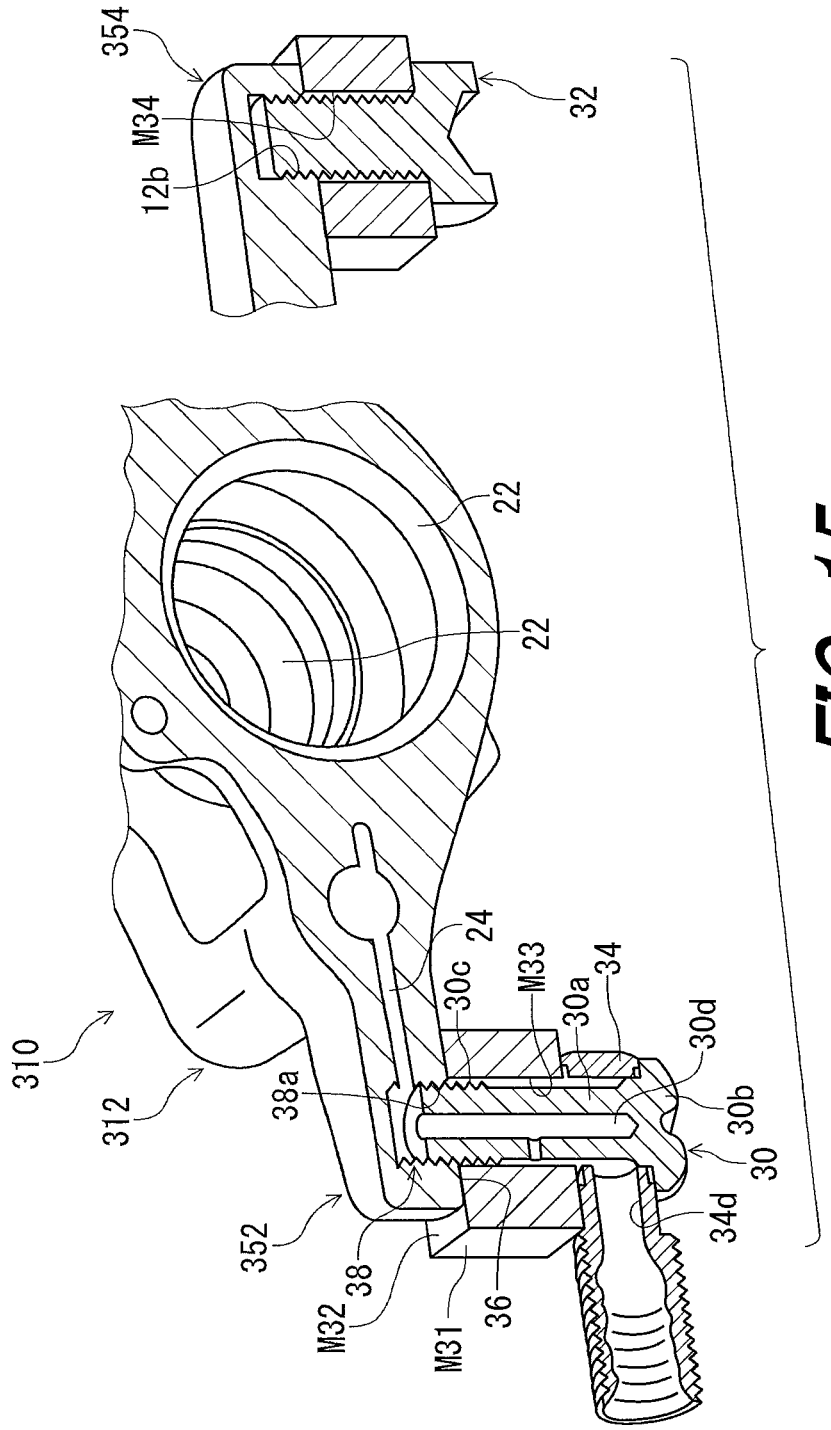


FIG. 14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34d
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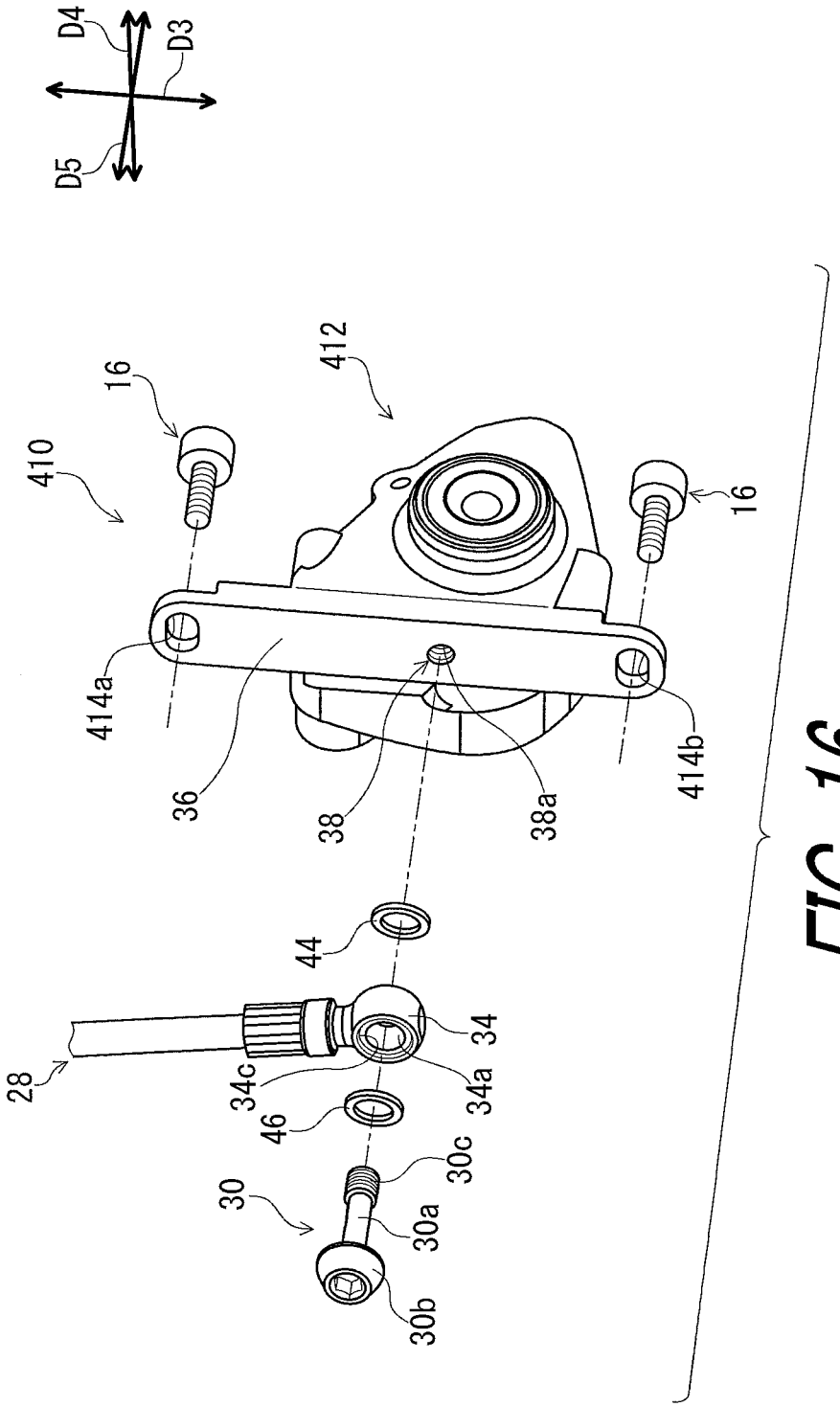
38
M32
M31
36

FIG. 15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34c
34a
46
30c
30
30a
30b

FIG. 16

DISC BRAKE CALIPER AND BASE MEMBER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a disc brake caliper and a base member.

2. Discussion of the Background

Bicycling is becoming an increasingly more popular form of recreation as well as a means of transportation. Moreover, bicycling has become a very popular competitive sport for both amateurs and professionals. Whether the bicycle is used for recreation, transportation or competition, the bicycle industry is constantly improving the various components of the bicycle. One component that has been extensively redesigned is a bicycle brake device. In particular, in recent years, bicycles have been provided with disc braking devices.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention, a disc brake caliper comprises a caliper main-body. The caliper main-body includes a facing surface and an attachment structure. The facing surface is configured to face a mounting portion of a bicycle frame to which the disc brake caliper is attached. A connecting member is to be attached to the attachment structure. The connecting member is configured to be connected to a fluid hose. The attachment structure is provided on the facing surface.

In accordance with a second aspect of the present invention, the disc brake caliper according to the first aspect is configured so that the caliper main-body further includes a recess configured to arrange a piston such that the piston moves in a first direction. The facing surface is parallel to the first direction.

In accordance with a third aspect of the present invention, the disc brake caliper according to the second aspect is configured so that the attachment structure includes an attachment hole provided on the facing surface. The connecting member is attached to the attachment hole.

In accordance with a fourth aspect of the present invention, the disc brake caliper according to the third aspect is configured so that the attachment hole extends in a second direction perpendicular to the first direction.

In accordance with a fifth aspect of the present invention, the disc brake caliper according to the third aspect is configured so that the caliper main-body further includes a mounting hole through which a mounting member is to extend in a state where the caliper main-body is mounted to the mounting portion of the bicycle frame via the mounting member. The attachment hole and the mounting hole extend in a second direction.

In accordance with a sixth aspect of the present invention, the disc brake caliper according to the fifth aspect is configured so that the second direction is perpendicular to the first direction.

In accordance with a seventh aspect of the present invention, the disc brake caliper according to the second aspect is configured so that the connecting member comprises a banjo fitting bolt configured to be coupled to a banjo.

In accordance with an eighth aspect of the present invention, the disc brake caliper according to the second aspect is configured so that the attachment structure is provided downstream of the piston in a positive rotational direction of a brake disc rotor in a state where the caliper main-body is mounted to the mounting portion of the bicycle frame.

In accordance with a ninth aspect of the present invention, the disc brake caliper according to the first aspect further comprises a base member configured to be arranged between the caliper main-body and the mounting portion of the bicycle frame and configured to be mounted to the mounting portion. The caliper main-body is configured to be coupled to the base member. The facing surface faces the mounting portion via the base member in a state where the caliper main-body is coupled to the base member.

In accordance with a tenth aspect of the present invention, the disc brake caliper according to the ninth aspect is configured so that the base member includes a through-hole through which the connecting member is to extend in a state where the connecting member is attached to the attachment structure.

In accordance with an eleventh aspect of the present invention, a bicycle click brake caliper comprises a caliper main-body. The caliper main-body includes a slit, a facing surface and an attachment structure. A brake disc rotor is to be arranged in the slit. The slit includes an outlet opening from which the brake disc rotor is to exit in a positive rotational direction of the brake disc rotor. The facing surface is configured to face in the positive rotational direction. A connecting member is to be attached to the attachment structure. The connecting member is configured to be connected to a fluid hose. The attachment structure is provided on the facing surface.

In accordance with a twelfth aspect of the present invention, a disc brake caliper comprises a caliper main-body. The caliper main-body includes a recess and an attachment hole. The recess is configured to arrange a piston such that the piston moves in a first direction. A banjo fitting bolt is to be attached to the attachment hole. The attachment hole extends in a second direction non-parallel to the first direction.

In accordance with a thirteenth aspect of the present invention, the disc brake caliper according to the twelfth aspect is configured so that the caliper main-body further includes a facing surface configured to face a mounting portion of a bicycle frame. The attachment hole is provided on the facing surface.

In accordance with a fourteenth aspect of the present invention, a disc brake caliper comprises a caliper main-body and a connecting member. The caliper main-body includes an attachment hole and a caliper fluid passage extending from the attachment hole. The connecting member is configured to be connected to a fluid hose. The connecting member is configured to be attached to the attachment hole to couple the caliper main-body to one of a mounting portion of a bicycle frame and a base member configured to mount the caliper main-body to the mounting portion.

In accordance with a fifteenth aspect of the present invention, the disc brake caliper according to the fourteenth aspect is configured so that the connecting member comprises a banjo fitting bolt including an intermediate fluid passage configured to connect a banjo fluid passage of a banjo to the caliper fluid passage.

In accordance with a sixteenth aspect of the present invention, the disc brake caliper according to the fifteenth aspect is configured so that the caliper main-body further includes a facing surface configured to face the mounting portion of the bicycle frame. The attachment hole is provided on the facing surface.

In accordance with a seventeenth aspect of the present invention, a base member for mounting a caliper main-body to a mounting portion of a bicycle frame comprises a through-hole through which a connecting member configured to be connected to a fluid hose and to be attached to the caliper main-body is to extend.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is a partial side elevational view of a bicycle with a disc brake caliper in accordance with a first embodiment;

FIG. **2** is a schematic structural diagram of the disc brake caliper illustrated in FIG. **1**;

FIG. **3** is an exploded perspective view of the disc brake caliper illustrated in FIG. **1**;

FIG. **4** is an exploded perspective view of the disc brake caliper illustrated in FIG. **1**;

FIG. **5** is a top view of a caliper main-body of the disc brake caliper illustrated in FIG. **1**;

FIG. **6** is a cross-sectional view of a caliper main-body of the disc brake caliper taken along line VI-VI of FIG. **4**;

FIG. **7** is a partial cross-sectional view of the disc brake caliper illustrated in FIG. **1**;

FIG. **8** is an elevational view of the disc brake caliper illustrated in FIG. **1** (first position);

FIG. **9** is an elevational view of the disc brake caliper illustrated in FIG. **1** (second position);

FIG. **10** is an exploded perspective view of a disc brake caliper in accordance with a second embodiment;

FIG. **11** is an elevational view of the disc brake caliper illustrated in FIG. **10** (first position);

FIG. **12** is an elevational view of the disc brake caliper illustrated in FIG. **10** (second position);

FIG. **13** is a partial side elevational view of a bicycle with a disc brake caliper in accordance with a third embodiment;

FIG. **14** is a perspective view of the disc brake caliper illustrated in FIG. **13**;

FIG. **15** is a cross-sectional view of a caliper main-body of the disc brake caliper taken along line XIV-XIV of FIG. **14**; and

FIG. **16** is an exploded perspective view of a disc brake caliper in accordance with a fourth embodiment.

DESCRIPTION OF THE EMBODIMENTS

The embodiments will now be described with reference to the accompanying drawings, wherein like reference numerals designate corresponding or identical elements throughout the various drawings.

First Embodiment

Referring initially to FIG. **1**, a part of a bicycle is illustrated that includes a disc brake caliper **10** in accordance with a first embodiment. The disc brake caliper **10** is mounted to a bicycle frame **1**. The disc brake caliper **10** is constructed for selectively gripping (stopping rotation) of a brake disc rotor **2** that is fixedly attached to a bicycle hub assembly **3** of a bicycle wheel (not shown). The brake disc rotor **2** is rotatable relative to the bicycle frame **1** about a rotational axis RA in a rotational direction D. The rotational direction D includes a positive rotational direction D**1** and a negative rotational direction D**2** opposite to the positive rotational direction D**1**. The positive rotational direction D**1** of the brake disc rotor **2** is defined as a direction in which the brake disc rotor **2** rotates when the bicycle moves forward. The negative rotational direction D**2** of the brake disc rotor **2** is defined as a direction in which the brake disc rotor **2** rotates when the bicycle moves rearward. In the illustrated embodiment, the disc brake caliper **10** is a front disc brake and is mounted to a front fork **1***a* of the bicycle frame **1**. The disc brake caliper **10** can, however, be applied to a rear disc brake. The disc brake caliper **10** is configured to be actuated by a hydraulic fluid provided from an operating device (not shown). Since the operation device includes structures which have been known in the bicycle field, the operating device will not be described and/or illustrated in detail herein for the sake of brevity.

In the present application, the following directional terms "front", "rear", "forward", "rearward", "left", "right", "transverse", "upward" and "downward" as well as any other similar directional terms refer to those directions which are determined on the basis of a rider who sits on a saddle (not shown) of the bicycle with facing a handlebar (not shown), for example. Accordingly, these terms, as utilized to describe the disc brake caliper, should be interpreted relative to the bicycle as used in an upright riding position on a horizontal surface.

As seen in FIG. **1**, the disc brake caliper **10** comprises a caliper main-body **12**. The caliper main-body **12** is fluidly connected to the operating device. In the illustrated embodiment, the disc brake caliper **10** is so configured that relative position between the rotational axis RA and the caliper main-body **12** is adjustable in a radial direction D**3** of the brake disc rotor **2**. More specifically, the disc brake caliper **10** further comprises a base member **14** for mounting the caliper main-body **12** to a mounting portion M**1** of the bicycle frame **1**. The base member **14** is a separate member from the caliper main-body **12**. The caliper main-body **12** and the base member **14** are made of metallic material such as an aluminum alloy or iron. The base member **14** is configured to be arranged between the caliper main-body **12** and the mounting portion M**1** of the bicycle frame **1**. The caliper main-body **12** is configured to be coupled to the base member **14**. The base member **14** is configured to be mounted to the mounting portion M**1**. In the illustrated embodiment, the base member **14** is mounted to the front fork **1***a* of the bicycle frame **1** by a pair of first mounting members **16** (e.g., bolts). The base member **14** is configured to be coupled to the caliper main-body **12** and to be attached to the bicycle frame **1** (the front fork **1***a*) such that relative position between the rotational axis RA and the caliper main-body **12** is adjustable in the radial direction D**3** of the brake disc rotor **2**. The base member **14** will be described and/or illustrated in detail later.

As seen in FIG. **2**, the disc brake caliper **10** further comprises a pair of pistons **18** and a pair of brake pads **20**. The pistons **18** are arranged to press the brake pads **20** toward the brake disc rotor **2**, respectively. The caliper main-body **12** further includes recesses **22** and a caliper fluid passage **24**. The recess **22** is configured to arrange the piston **18** such that the piston **18** moves in a first direction (a transverse direction) D**4**. Fluid chambers **26** are defined by the pistons **18** and the recesses **22**, respectively. The Fluid chambers **26** are in fluid communication with the caliper fluid passage **24**. The caliper fluid passage **24** is in fluid communication with a master cylinder (not shown) of the operating device via a fluid hose **28**. In the illustrated embodiment, the first direction D**4** is parallel to the rotational axis RA of the brake disc rotor **2** in a state where the disc brake caliper **10** is mounted to the front fork **1***a* of the bicycle frame **1** (FIG. **1**). However, the first direction D**4** can be non-parallel to the rotational axis RA.

As seen in FIG. **3**, the base member **14** is mounted to the mounting portion M**1** of the bicycle frame **1** by the first mounting members **16**. The base member **14** includes a pair of first mounting holes **14***a* and **14***b*. The first mounting holes **14***a* and **14***b* are configured as a through hole without having a thread portion, respectively. The first mounting members **16** extend through the first mounting holes **14***a* and **14***b* respec-

tively in a state where the disc brake caliper **10** is mounted to the mounting portion M1 of the bicycle frame **1**. In the disc brake caliper **10** depicted in FIG. **3**, parts other than the caliper main-body **12** (e.g., the brake pads **20** and the pistons **18**) are omitted for the sake of brevity.

The mounting portion M1 of the bicycle frame **1** includes a mounting surface M2 and a pair of threaded holes M3 and M4 provided on the mounting surface M2. The mounting surface M2 is configured to contact the base member **14**. The base member **14** is mounted on the mounting surface M2 of the bicycle frame **1**. The first mounting members **16** are attached to the threaded holes M3 and M4. The mounting portion M1 further includes a cavity M5. The cavity M5 is provided between the threaded holes M3 and M4. The disc brake caliper **10** further includes a connecting member **30**. The connecting member **30** is at least partially disposed in the cavity M5 in a state where the disc brake caliper **10** is mounted to the bicycle frame **1**.

The disc brake caliper **10** includes a pair of second mounting members **32** (e.g., bolts). The base member **14** includes a pair of second mounting holes **14***c* and **14***d*. The second mounting holes **14***c* and **14***d* are configured as a through hole without having a thread portion, respectively. The base member **14** is mounted or coupled to the caliper main-body **12** using the second mounting members **32**. The second mounting members **32** extend through the second mounting holes **14***c* and **14***d* respectively in a state where the base member **14** is coupled to the caliper main-body **12**.

As seen in FIG. **4**, the caliper main-body **12** further includes third mounting holes **12***a* and **12***b* through which the second mounting members **32** are to extend respectively in a state where the caliper main-body **12** is mounted to the mounting portion M1 of the bicycle frame **1** via the first mounting members **16** and the second mounting members **32**. In the illustrated embodiment, each of the third mounting holes **12***a* and **12***b* includes a threaded hole. The second mounting members **32** are threaded into the third mounting holes **12***a* and **12***b* in a state where the base member **14** is coupled to the caliper main-body **12**. In this first embodiment, the third mounting holes and the second mounting members correspond to "mounting hole" and "mounting member" defined in claim.

The connecting member **30** is configured to be connected to the fluid hose **28** and to be attached to the caliper main-body **12**. The fluid hose **28** includes a banjo **34** provided at an end of the fluid hose **28**. In the illustrated embodiment, the connecting member **30** comprises a banjo fitting bolt configured to be coupled to the banjo **34**. The connecting member **30** can hereinafter be referred to as a banjo fitting bolt **30**. In the illustrated embodiment, the fluid hose **28** is connected to the caliper main-body **12** by the banjo fitting bolt **30** and the banjo **34**. The connecting member **30** can, however, include structures other than a banjo fitting bolt if needed and/or desired.

The caliper main-body **12** includes a facing surface **36** and an attachment structure **38** to which the banjo fitting bolt **30** is to be attached. The attachment structure **38** is provided on the facing surface **36**. In the illustrated embodiment, as seen in FIG. **5**, the facing surface **36** is parallel to the first direction D4. However, the facing surface **36** can be non-parallel to the first direction D4 and can be inclined with respect to the first direction D4 if needed and/or desired.

As seen in FIGS. **4** and **6**, the caliper main-body **12** includes a slit **40** in which the brake disc rotor **2** is to be arranged. The slit **40** includes an outlet opening **40***a* from which the brake disc rotor **2** is to exit in the positive rotational direction D1 of the brake disc rotor **2** (FIG. **6**). The outlet opening **40***a* is provided on the facing surface **36**.

As seen in FIG. **4**, the attachment structure **38** includes an attachment hole **38***a* provided on the facing surface **36**. The banjo fitting bolt **30** is attached to the attachment hole **38***a*. In other words, the caliper main-body **12** includes the attachment hole **38***a* to which the banjo fitting bolt **30** is to be attached. The attachment hole **38***a* extends in a second direction D5 non-parallel to the first direction D4. In the illustrated embodiment, as seen in FIG. **5**, the attachment hole **38***a* extends in the second direction D5 perpendicular to the first direction D4 and in a substantial forward and rearward direction. However, the attachment hole **38***a* can be disposed to extend in a direction which is not perpendicular to the first direction D4 if needed and/or desired.

As seen in FIG. **4**, the attachment hole **38***a* and the third mounting holes **12***a* and **12***b* extend in the second direction D5. In the illustrated embodiment, the second direction D5 is perpendicular to the first direction D4 as described above. However, the attachment hole **38***a* and the third mounting holes **12***a* and **12***b* can be disposed to extend to other direction than the direction D5 if needed and/or desired.

As seen in FIG. **4**, the base member **14** comprises a through-hole **14***e* through which the banjo fitting bolt **30** is to extend in a state where the banjo fitting bolt **30** is attached to the attachment structure **38**. The base member **14** includes a cylindrical protrusion **14***f* defining a part of the through-hole **14***e*. The banjo fitting bolt (connecting member) **30** includes a shaft portion **30***a* and a head portion **30***b* provided at an end of the shaft portion **30***a*. The shaft portion **30***a* includes an externally threaded part **30***c*. The banjo **34** includes a banjo opening **34***a* through which the connecting member **30** is to extend. The shaft portion **30***a* extends through the banjo opening **34***a* and the through-hole **14***e* of the base member **14** and is screwed in the attachment hole **38***a* in a state where the banjo **34** and the base member **14** are attached to the caliper main-body **12**.

As seen in FIG. **7**, a seal member **42** is provided in an annular recess **14***g* of the base member **14** between the base member **14** and the caliper main-body **12**. A seal member **44** is provided in an annular recess **34***b* of the banjo **34** between the banjo **34** and the cylindrical protrusion **14***f* of the base member **14**. A seal member **46** is provided in an annular recess **34***c* of the banjo **34** between the banjo **34** and the head portion **30***b* of the connecting member **30**.

The banjo **34** includes a banjo fluid passage **34***d* in fluid communication with a fluid passage **28***a* of the fluid hose **28**. The caliper fluid passage **24** extends from the attachment hole **38***a*. The caliper fluid passage **24** of the caliper main-body **12** is in fluid communication with the attachment hole **38***a* of the attachment structure **38**. A fluid passage space S is defined by the banjo fitting bolt **30**, the banjo **34**, and the base member **14** in a state where the banjo **34** is attached to the base member **14** with the banjo fitting bolt **30**. The fluid passage space S is sealed by the seal members **42**, **44** and **46**. The fluid passage space S is in fluid communication with the banjo fluid passage **34***d*. The banjo fitting bolt **30** includes an intermediate fluid passage **30***d* configured to connect the banjo fluid passage **34***d* of the banjo **34** to the caliper fluid passage **24**. The intermediate fluid passage **30***d* is configured to connect the fluid passage space S to the caliper fluid passage **24**. Accordingly, the banjo fluid passage **34***d* is in fluid communication with the caliper fluid passage **24** via the fluid passage space S and the intermediate fluid passage **30***d*.

As seen in FIG. **8**, the front fork **1***a* includes a hose duct **1***b* extending along the front fork **1***a* from the cavity M5 toward an upper portion of the front fork **1***a*. The fluid hose **28** extends through the hose duct **1***b*. The hose duct **1***b* includes an inlet opening (not shown) at the upper portion of the front

fork **1***a*. The fluid hose **28** passes through the inlet opening of the hose duct **1***b* and is fluidly connected to the master cylinder of the operating device.

The facing surface **36** is configured to face the mounting portion M1 of the bicycle frame **1** to which the disc brake caliper **10** is attached. In the illustrated embodiment, the facing surface **36** faces the mounting portion M1 via the base member **14** in a state where the caliper main-body **12** is coupled to the base member **14**. Further, the facing surface **36** faces in the positive rotational direction D1. The attachment structure **38** is provided downstream of the piston **18** in the positive rotational direction D1 of the brake disc rotor **2** in a state where the caliper main-body **12** is mounted to the mounting portion M1 of the bicycle frame **1**. The arrangements of the facing surface **36** and the attachment structure **38** are not limited to the illustrated embodiment. For example, the facing surface **36** can be disposed to face in a direction other than the positive rotational direction D1.

With the disc brake caliper **10**, the attachment structure **38** to which the banjo fitting bolt **30** is to be attached is provided on the facing surface **36** configured to face the mounting portion M1 of the bicycle frame **1**. Accordingly, at least part of the banjo fitting bolt (connecting member) **30** and/or the fluid hose **28** is less likely to be seen in a state where the disc brake caliper **10** is mounted to the mounting portion M1 of the bicycle frame **1**. This allows appearance of the disc brake caliper **10** to be simplified.

As seen in FIG. **8**, the through-hole **14***e* is closer to the first mounting hole **14***b* than the first mounting hole **14***a*. The through-hole **14***e* is disposed at a middle position between the second mounting hole **14***c* and the second mounting hole **14***d*. As seen in FIG. **9**, the orientation of the base member **14** is turned upside down relative to the caliper main-body **12** compared with the orientation of the base member **14** illustrated in FIG. **8**. As seen in FIGS. **8** and **9**, changing the orientation of the base member **14** relative to the caliper main-body **12** allows the relative position between the rotational axis RA and the caliper main-body **12** to be adjusted to each of brake disc rotors having different outer diameters R1 and R2. The structure of the base member **14** is not limited to the illustrated embodiment. For example, the disc brake caliper **10** can has a structure such that the relative position between the rotational axis RA and the caliper main-body **12** is not adjustable.

Second Embodiment

A disc brake caliper **210** in accordance with a second embodiment will be described below referring to FIGS. **10** to **12**. The disc brake caliper **210** has substantially the same configuration as the disc brake caliper **10** except for the structures of the caliper main-body and the base member. Thus, elements having substantially the same function as those in the first embodiment will be numbered the same here, and will not be described and/or illustrated again in detail here for the sake of brevity.

As seen in FIGS. **10** and **11**, the disc brake caliper **210** comprises a caliper main-body **212**. The caliper main-body **212** includes the attachment hole **38***a*. The caliper fluid passage **24** extends from the attachment hole **38***a* (FIG. **7**). The connecting member **30** is configured to be attached to the attachment hole **38***a* to couple the caliper main-body **212** to one of the mounting portion M1 of the bicycle frame **1** and a base member **214** configured to mount the caliper main-body **212** to the mounting portion M1. In the illustrated embodiment, the banjo fitting bolt **30** is configured to be attached to the attachment hole **38***a* to couple the caliper main-body **212** to the base member **214**. Unlike the first embodiment, the banjo fitting bolt (connecting member) **30** serves as the second mounting member **32**, and the base member **214** is coupled to the caliper main-body **212** using the connecting member **30** and the second mounting member **32**. In other words, in comparison with the first embodiment, the third mounting hole **12***a* is omitted, and the attachment hole **38***a* is used as a mounting hole also.

The base member **214** includes second mounting holes **214***c* and **214***d*, and cylindrical protrusions **214***e* and **214***f*. The second mounting holes **214***c* and **214***d* are configured as a through hole without having a thread portion, respectively. The cylindrical protrusion **214***e* defines a part of the second mounting hole **214***c*. The cylindrical protrusion **214***f* defines a part of the second mounting hole **214***d*. The base member **214** is coupled to the caliper main-body **212** using the banjo fitting bolt **30** and the second mounting member **32**. The banjo fitting bolt **30** and the second mounting member **32** extend through the second mounting holes **214***c* and **214***d* in a state where the base member **214** is coupled to the caliper main-body **212** using the banjo fitting bolt **30** and the second mounting member **32**.

With the disc brake caliper **210**, the attachment structure **38** to which the banjo fitting bolt **30** is to be attached is provided on the facing surface **36** configured to face the mounting portion M1 of the bicycle frame **1**. Accordingly, at least part of banjo fitting bolt **30** and/or the fluid hose **28** is less likely to be seen in a state where the disc brake caliper **210** is mounted to the mounting portion M1 of the bicycle frame **1**. This allows appearance of the disc brake caliper **210** to be simplified.

Furthermore, since the caliper main-body **212** is coupled to the base member **214** using the banjo fitting bolt **30**, the third mounting hole **12***a* (FIG. **4**) and one of the second mounting members **32** (FIG. **4**) can be omitted. This allows the structure of the disc brake caliper **210** to be simplified.

As seen in FIGS. **11** and **12**, changing the orientation of the base member **214** relative to the caliper main-body **212** allows the relative position between the rotational axis RA and the caliper main-body **212** to be adjusted to each of brake disc rotors having different outer diameters R1 and R2, as well as the first embodiment. The structure of the base member **214** is not limited to the illustrated embodiment. For example, the disc brake caliper **210** can has a structure such that the relative position between the rotational axis RA and the caliper main-body **212** is not adjustable.

Third Embodiment

A disc brake caliper **310** in accordance with a third embodiment will be described below referring to FIGS. **13** to **15**. The disc brake caliper **310** has substantially the same configuration as the disc brake caliper **10** except for the structures of the caliper main-body and the base member. Thus, elements having substantially the same function as those in the first embodiment will be numbered the same here, and will not be described and/or illustrated again in detail here for the sake of brevity.

As seen in FIG. **13**, the disc brake caliper **310** comprises a caliper main-body **312**. The caliper main-body **312** is mounted to a mounting portion M31 of the bicycle frame **1**. Since the disc brake caliper **310** is a rear disc brake, the disc brake caliper **310** is mounted to the mounting portion M31 provided on a rear stay **1***c* opposite to a chain stay (not shown) of the bicycle frame **1**. The caliper main-body **312** includes a first coupling portion **352** and a second coupling portion **354**.

The first coupling portion **352** and the second coupling portion **354** are attached to the mounting portion M**31** of the bicycle frame **1**.

As seen in FIG. **14**, the mounting portion M**31** of the bicycle frame **1** includes a mounting surface M**32**. The caliper main-body **312** is mounted on the mounting surface M**32**. The first coupling portion **352** and the second coupling portion **354** are disposed on the mounting surface M**32**.

As seen in FIG. **15**, the caliper main-body **312** includes the attachment hole **38***a*. The caliper fluid passage **24** extends from the attachment hole **38***a*. The disc brake caliper **310** comprises the banjo fitting bolt **30**. The banjo fitting bolt **30** is configured to be attached to the attachment hole **38***a* to couple the caliper main-body **312** to the mounting portion M**31** of the bicycle frame **1**. The attachment hole **38***a* of the attachment structure **38** is provided in the first coupling portion **352**. The third mounting hole **12***b* (hereinafter, the mounting hole **12***b*) is provided in the second coupling portion **354**. The second mounting member **32** (hereinafter, the mounting member **32** simply) is attached to the mounting hole **12***b*.

The mounting portion M**31** of the bicycle frame **1** includes a pair of mounting through-holes M**33** and M**34** provided on the mounting surface M**32**. The banjo fitting bolt **30** and the mounting member **32** extend through the mounting through-holes M**33** and M**34**.

As seen in FIG. **15**, The facing surface **36** is provided on the first coupling portion **352**. The facing surface **36** is configured to face the mounting portion M**31** of the bicycle frame **1** to which the disc brake caliper **310** is attached. In the illustrated embodiment, the facing surface **36** contacts the mounting portion M**31** in a state where the caliper main-body **312** is attached to the mounting portion M**31**.

With the disc brake caliper **310**, the attachment structure **38** to which the banjo fitting bolt **30** is to be attached is provided on the facing surface **36** configured to face the mounting portion M**31** of the bicycle frame **1**. Accordingly, at least part of the banjo fitting bolt (connecting member) **30** and/or the fluid hose **28** is less likely to be seen in a state where the disc brake caliper **310** is mounted to the mounting portion M**31** of the bicycle frame **1**. This allows appearance of the disc brake caliper **310** to be simplified.

Furthermore, since the caliper main-body **312** is directly coupled to the mounting portion M**31** of the bicycle frame **1** using the banjo fitting bolt **30** without base member, the third mounting hole **12***a*, one of the mounting members **32**, and the base member **14** (FIG. **4**) can be omitted. This allows the structure of the disc brake caliper **310** to be simplified.

Fourth Embodiment

A disc brake caliper **410** in accordance with a fourth embodiment will be described below referring to FIG. **16**. The disc brake caliper **410** has substantially the same configuration as the disc brake caliper **10** except for the structures of the caliper main-body and the base member. Thus, elements having substantially the same function as those in the first embodiment will be numbered the same here, and will not be described and/or illustrated again in detail here for the sake of brevity.

As seen in FIG. **16**, the base member **14** (FIG. **3**) in accordance with the first embodiment is omitted from the disc brake caliper **10**. The disc brake caliper **410** comprises a caliper main-body **412**. The caliper main-body **412** includes the facing surface **36** and the attachment structure **38**. The caliper main-body **412** further includes first mounting holes **414***a* and **414***b* (hereinafter, the mounting holes **414***a* and **414***b* simply) which are provided on the facing surface **36**. The first mounting members **16** (hereinafter, the mounting members **16** simply) extend through the mounting holes **414***a* and **414***b*, respectively. The facing surface **36** is configured to face the mounting portion M**1** of the bicycle frame **1** (FIG. **3**). Since the base member **14** in accordance with the first embodiment is omitted from the disc brake caliper **10**, the facing surface **36** is configured to contact the mounting portion M**1** of the bicycle frame **1** (FIG. **3**).

With the disc brake caliper **410**, the attachment structure **38** to which the banjo fitting bolt **30** is to be attached is provided on the facing surface **36** configured to face the mounting portion M**1** of the bicycle frame **1**. Accordingly, at least part of the banjo fitting bolt (connecting member) **30** and/or the fluid hose **28** is less likely to be seen in a state where the disc brake caliper **410** is mounted to the mounting portion M**1** of the bicycle frame **1**. This allows appearance of the disc brake caliper **410** to be simplified.

In the above embodiments, the term "attached" or "attaching", as used herein, encompasses configurations in which an element directly attached to another element by affixing the element is directly to the other element; configurations in which the element is indirectly attached to the other element via the intermediate member(s); and configurations in which one element is integral with another element, i.e. one element is essentially part of the other element. This concept also applies to words of similar meaning, for example, "joined", "connected", "coupled", "mounted", "bonded", "fixed" and their derivatives.

The term "comprising" and its derivatives, as used herein, are intended to be open ended terms that specify the presence of the stated features, elements, components, groups, integers, and/or steps, but do not exclude the presence of other unstated features, elements, components, groups, integers and/or steps. This concept also applies to words of similar meaning, for example, the terms "have", "include" and their derivatives.

The terms "member", "section", "portion", "part" and "element" when used in the singular can have the dual meaning of a single part or a plurality of parts.

The ordinal numbers such as "first" and "second" recited in the present application are merely identifiers, but do not have any other meanings, for example, a particular order and the like. Moreover, for example, the term "first element" itself does not imply an existence of "second element", and the term "second element" itself does not imply an existence of "first element."

The term "pair of", as used herein, can encompass the configuration in which the pair of elements have different shapes or structures from each other in addition to the configuration in which the pair of elements have the same shapes or structures as each other.

Finally, terms of degree such as "substantially", "about" and "approximately" as used herein mean a reasonable amount of deviation of the modified term such that the end result is not significantly changed.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. A disc brake caliper comprising:

a caliper main-body including:

a facing surface that faces a mounting surface of a mounting portion of a bicycle frame, the mounting surface being a surface to which the disc brake caliper is attached; and

an attachment structure that receives a connecting member connected to a fluid hose, the attachment structure being provided on the facing surface, the attachment structure directly receiving the connecting member, the connecting member having a fluid passage connected to the fluid hose.

2. The disc brake caliper according to claim **1**, wherein

the caliper main-body further includes a recess configured to arrange a piston such that the piston moves in a first direction, and

the facing surface is parallel to the first direction.

3. The disc brake caliper according to claim **2**, wherein

the attachment structure includes an attachment hole provided on the facing surface, and

the connecting member is attached to the attachment hole.

4. The disc brake caliper according to claim **3**, wherein

the attachment hole extends in a second direction perpendicular to the first direction.

5. The disc brake caliper according to claim **3**, wherein

the caliper main-body further includes a mounting hole through which a mounting member is to extend in a state where the caliper main-body is mounted to the mounting portion of the bicycle frame via the mounting member, and

the attachment hole and the mounting hole extend in a second direction.

6. The disc brake caliper according to claim **5**, wherein

the second direction is perpendicular to the first direction.

7. The disc brake caliper according to claim **2**, wherein

the attachment structure is provided downstream of the piston in a positive rotational direction of a brake disc rotor in a state where the caliper main-body is mounted to the mounting portion of the bicycle frame.

8. The disc brake caliper according to claim **1**, further comprising:

a base member configured to be arranged between the caliper main-body and the mounting portion of the bicycle frame and configured to be mounted to the mounting portion, wherein

the caliper main-body is configured to be coupled to the base member, and

the facing surface faces the mounting portion via the base member in a state where the caliper main-body is coupled to the base member.

9. The disc brake caliper according to claim **8**, wherein

the base member includes a through-hole through which the connecting member is to extend in a state where the connecting member is attached to the attachment structure.

10. A disc brake caliper comprising:

a caliper main-body including:

a facing surface that faces a mounting surface of a mounting portion of a bicycle frame, the mounting surface being a surface to which the disc brake caliper is attached; and

an attachment structure that receives a connecting member connected to a fluid hose, the attachment structure being provided on the facing surface, the caliper main-body further including a recess configured to arrange a piston such that the piston moves in a first direction, the facing surface being parallel to the first direction, the connecting member comprising a banjo fitting bolt configured to be coupled to a banjo.

11. A bicycle disc brake caliper comprising:

a caliper main-body including:

a slit in which a brake disc rotor is to be arranged, the slit including an outlet opening from which the brake disc rotor is to exit in a positive rotational direction of the brake disc rotor;

a facing surface that faces in the positive rotational direction; and

an attachment structure that receives a connecting member connected to a fluid hose, the attachment structure being provided on the facing surface, the attachment structure directly receiving the connecting member, the connecting member having a fluid passage connected to the fluid hose.

12. A disc brake caliper comprising:

a caliper main-body including:

a facing surface configured to face a mounting portion of a bicycle frame;

a recess configured to arrange a piston such that the piston moves in a first direction; and

an attachment hole that receives a banjo fitting bolt having a fluid passage therein, the attachment hole extending in a second direction which is non-parallel to the first direction and which is perpendicular to the facing surface.

13. The disc brake caliper according to claim **12**, wherein

the attachment hole is provided on the facing surface.

14. The disc brake caliper according to claim **13**, wherein

the caliper main-body includes a mounting hole provided on the facing surface, and

the mounting hole extends in the second direction.

15. The disc brake caliper according to claim **14**, wherein

the caliper main-body includes an additional mounting hole provided on the facing surface,

the additional mounting hole extends in the second direction, and

the attachment hole is provided between the mounting hole and the additional mounting hole.

16. A disc brake caliper comprising:

a caliper main-body including an attachment hole, and a caliper fluid passage extending from the attachment hole; and

a connecting member that connects to a fluid hose, the connecting member being attached to the attachment hole to directly couple the caliper main-body to one of a mounting portion of a bicycle frame and a base member that mounts the caliper main-body to the mounting portion, the attachment hole directly receiving the connecting member, the connecting member having a fluid passage connected to the fluid hose.

17. A disc brake caliper comprising:

a caliper main-body including an attachment hole, and a caliper fluid passage extending from the attachment hole; and

a connecting member that connects to a fluid hose, the connecting member being attached to the attachment hole to directly couple the caliper main-body to one of a mounting portion of a bicycle frame and a base member that mounts the caliper main-body to the mounting portion, the connecting member comprising a banjo fitting bolt including an intermediate fluid passage configured to connect a banjo fluid passage of a banjo to the caliper fluid passage.

18. The disc brake caliper according to claim 17, wherein

the caliper main-body further includes a facing surface configured to face the mounting portion of the bicycle frame, and

the attachment hole is provided on the facing surface.

19. A base member for mounting a caliper main-body to a mounting portion of a bicycle frame, comprising:

a body having a through-hole that receives a connecting member configured to be connected to a fluid hose and to be attached to the caliper main-body, the through-hole extending through a surface of the body, the surface facing the mounting portion of the bicycle frame such that the connecting member is between the surface and the bicycle frame; and

a cylindrical protrusion extending from the surface of the body and defining a part of the through-hole.

20. The base member according to claim 19, wherein

the body includes a first mounting hole and a first additional mounting hole spaced apart from the first mounting hole, and

the through-hole of the body is provided between the first mounting hole and the first additional mounting hole.

21. The base member according to claim 20, wherein

the body includes a second mounting hole provided between the first mounting hole and the first additional mounting hole.

22. The base member according to claim 21, wherein

the body includes a second additional mounting hole provided between the first mounting hole and the first additional mounting hole.

23. The base member according to claim 22, wherein

the through-hole of the body is provided between the second mounting hole and the second additional mounting hole.

24. A disc brake caliper comprising:

a caliper main-body including:

a facing surface configured to face a mounting portion of a bicycle frame to which the disc brake caliper is attached; and

an attachment structure to which a connecting member configured to be connected to a fluid hose is to be attached, the attachment structure being provided on the facing surface such that the connecting member is between the facing surface and the bicycle frame, the attachment structure directly receiving the connecting member, the connecting member having a fluid passage connected to the fluid hose.

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